



Ballard Power Systems



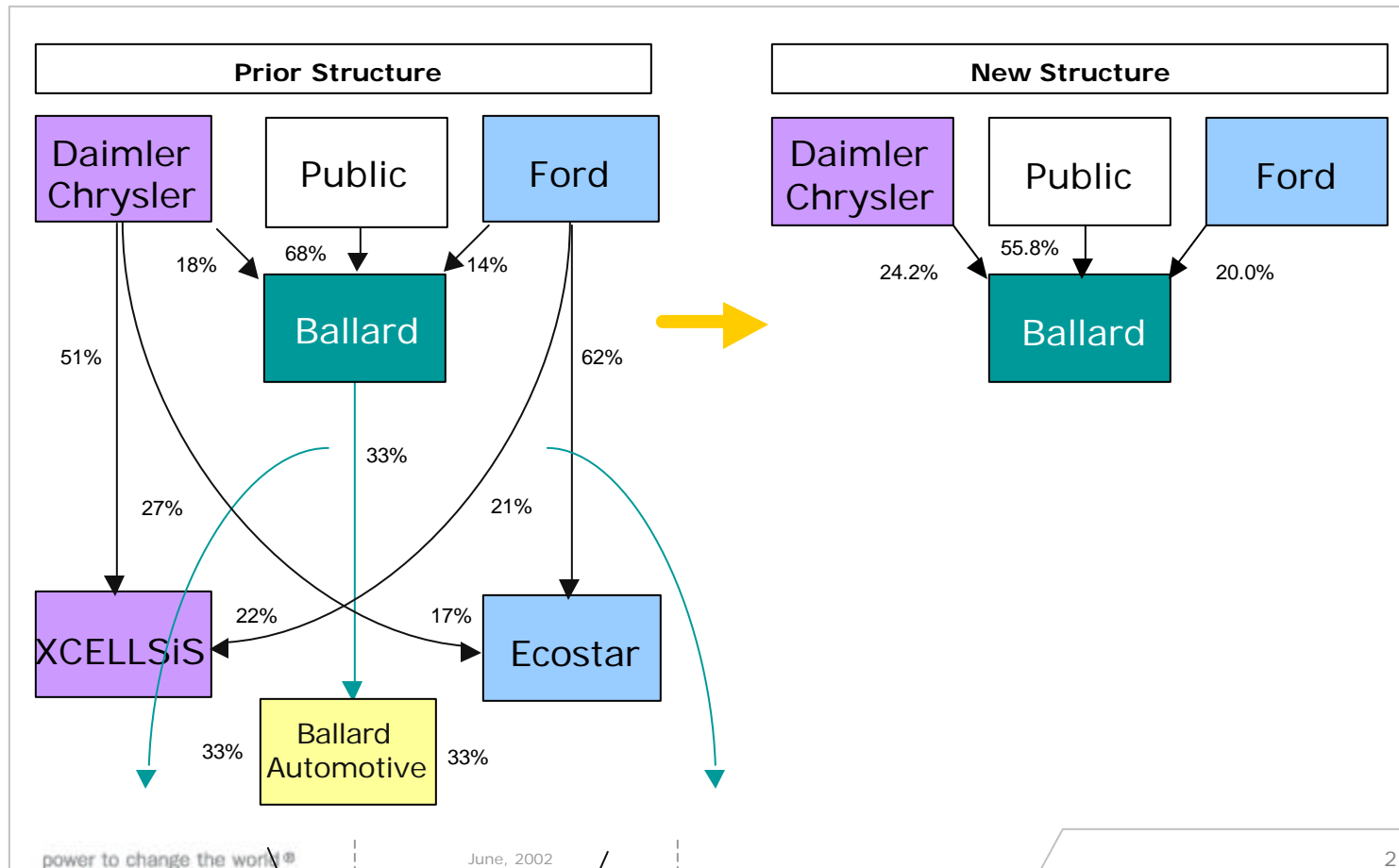
Fuel Cell Technology in Transportation Applications

Presented by Bruce Rothwell
Sales Manager - Heavy Duty

June, 2002

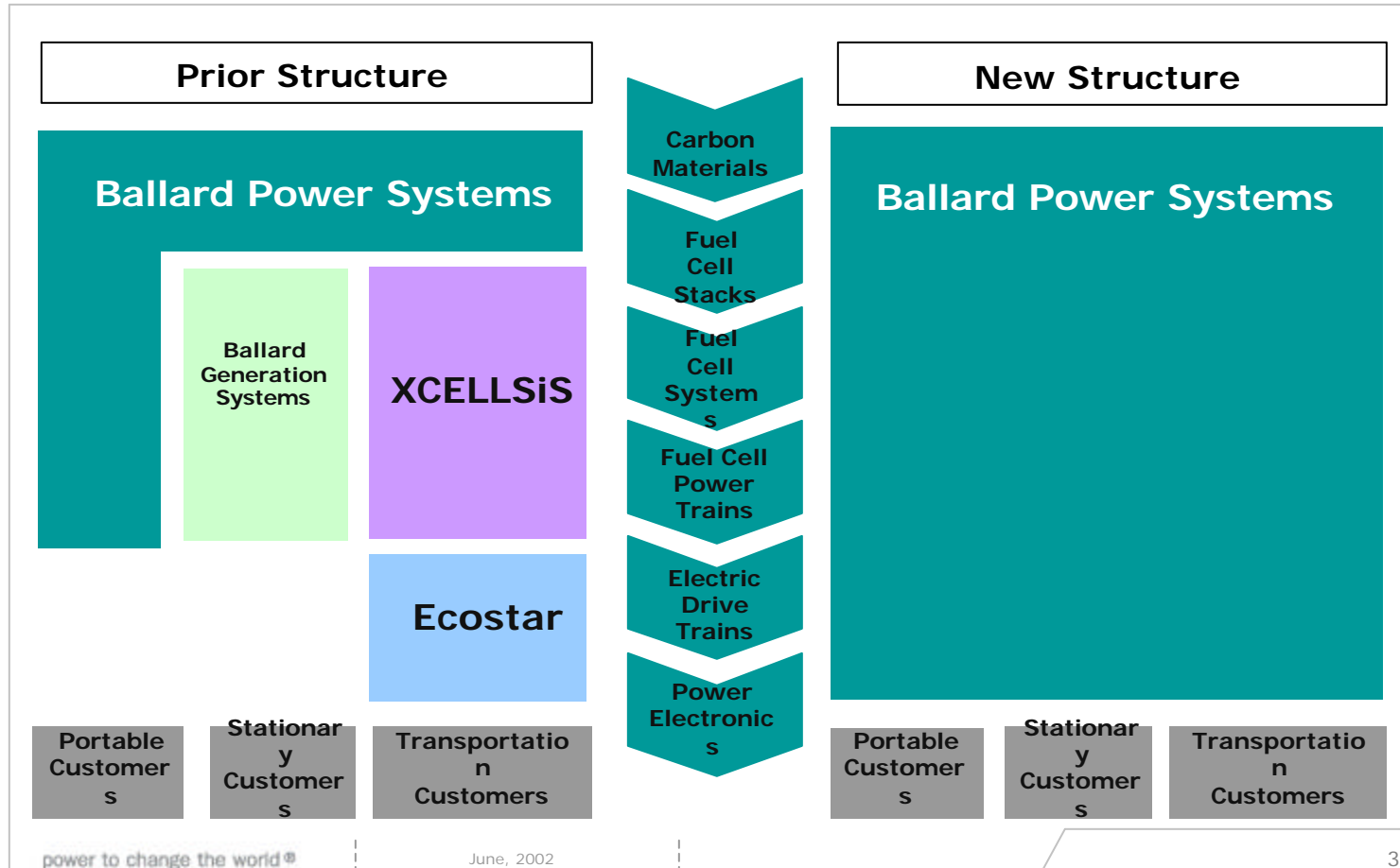
Ballard Today - Streamlining our Structure

BALLARD®



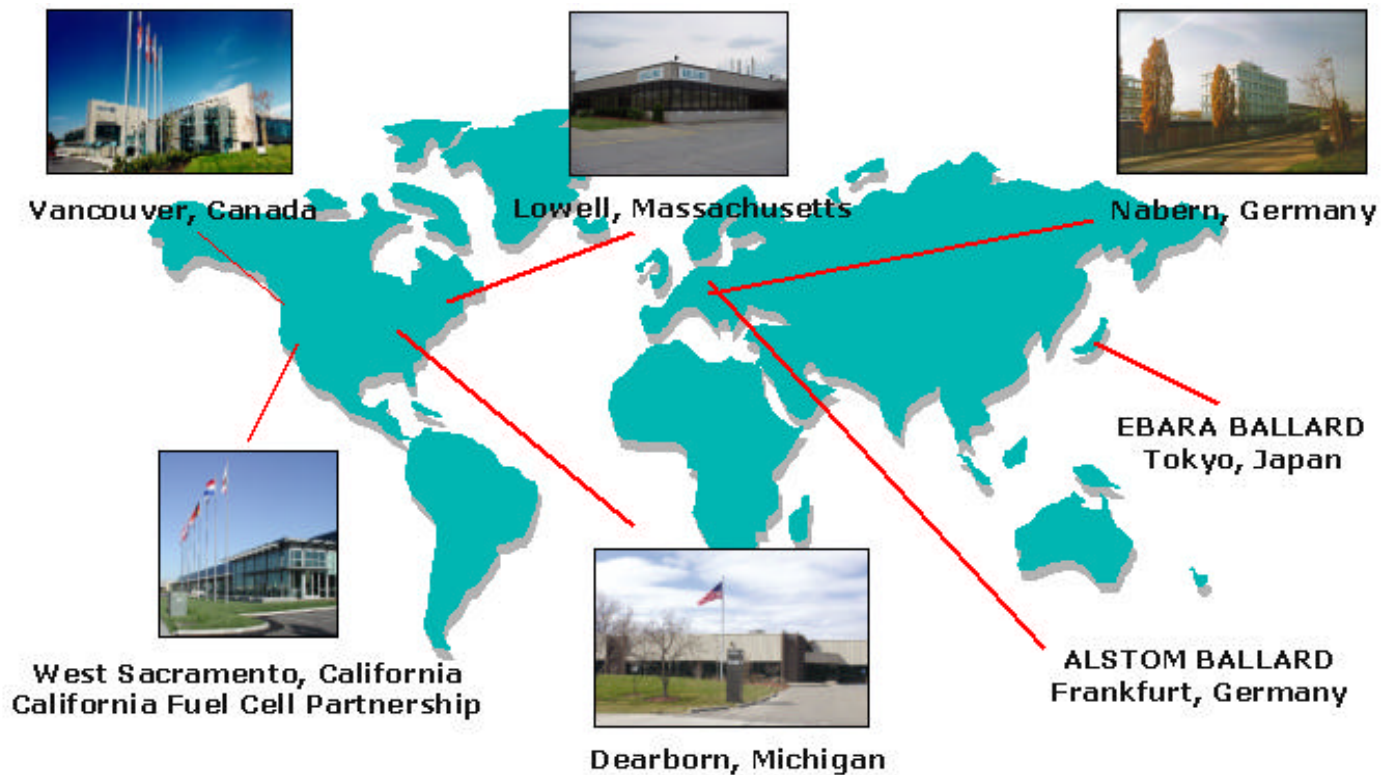
Streamlining our Operations

BALLARD®



Global Locations

BALLARD®



Customer and Market Focus

BALLARD®

Power Generation Division



Nexa™
Power Module



1 kW
Cogeneration
Stationary System



250 kW
Stationary
Power Generator

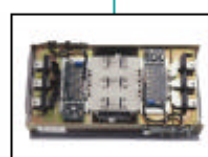
Electric Drives & Power Conversion Division



Electric Drive
Train



Auxiliary
Motor



Power Conversion
Electronics



Inverter

Material Products Division

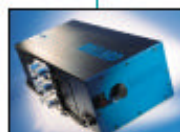


Carbon Fabric /
Friction Materials

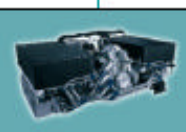


Carbon
Fiber Paper

Transportation Division



Mark 902
Fuel Cell
Power Module



Heavy-Duty
Fuel Cell Engine



Light-Duty
Hydrogen
Fuel Cell Engine



Light-Duty
Methanol
Fuel Cell Engine



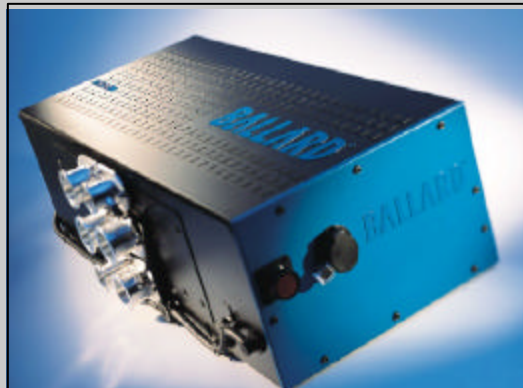
Auxiliary
Power Unit



Ballard Power Systems

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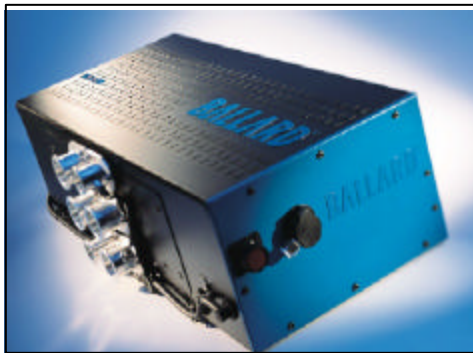
TRANSPORTATION DIVISION



- Ballard's Transportation Division works with many of the world's leading auto manufacturers to develop the next generation of efficient and clean engines for the world's fuel cell vehicles.

Mark 902 Fuel Cell Power Module

Ballard's most advanced fuel cell platform to date



- 85 kW (continuous maximum power)
- Increased reliability
- Lower cost
- Increased power density
- Increased compatibility with customer system requirements
- Unique flow field plates
- Capability for volume-manufacturing

Ballard® Light-Duty Fuel Cell Engines

BALLARD®



Xcellsis™ HY-75



Xcellsis™ ME-75



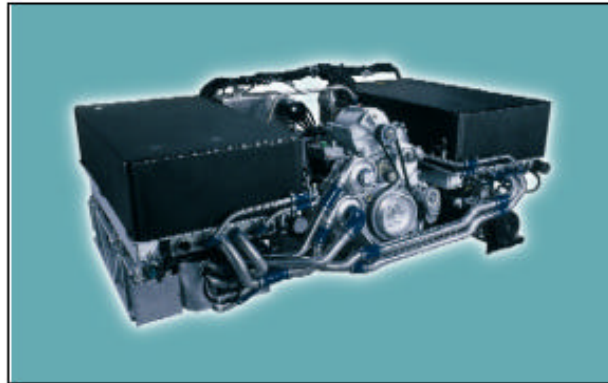
Ford Focus FCV



DaimlerChrysler
Jeep Commander 2

Ballard® Heavy-Duty Fuel Cell Engine

BALLARD®



Xcellsis™ HY-205



ZEBus



Citro Fuel Cell
Urban Transit Bus

Auxiliary Power Unit

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- Ballard offers small fuel cell systems or auxiliary power units (APUs) to supply a vehicle with clean, efficient onboard electricity.
- This electricity can be used to power:
 - Air conditioning systems
 - Mobile office equipment
 - Refrigeration systems
 - Microwave ovens
 - Televisions and VCRs



Transportation Prototypes

BALLARD®

- Passenger vehicles
 - 25 fuel cell vehicles demonstrated to date using Ballard® fuel cells
- Buses
 - 12 fuel cell buses demonstrated to date using Ballard® fuel cells
 - Previous trials in Chicago, Vancouver and Palm Springs
 - 30 buses in 10 European cities starting in 2003



California Fuel Cell Partnership - Preparing The Future

BALLARD®

- **Co-founded in 1999 by:**
 - Ballard, State of California, major auto-manufacturers and energy companies
- **Currently has 20 partners and 9 associate partners**
- **Mission:**
 - Demonstrate vehicle technology
 - Demonstrate alternative fuel infrastructure
 - Explore the path to commercialization
 - Increase public awareness
- **Demonstrations**
 - The Partnership will place more than 70 fuel cell vehicles (cars and buses) on the road between 2000 and 2003



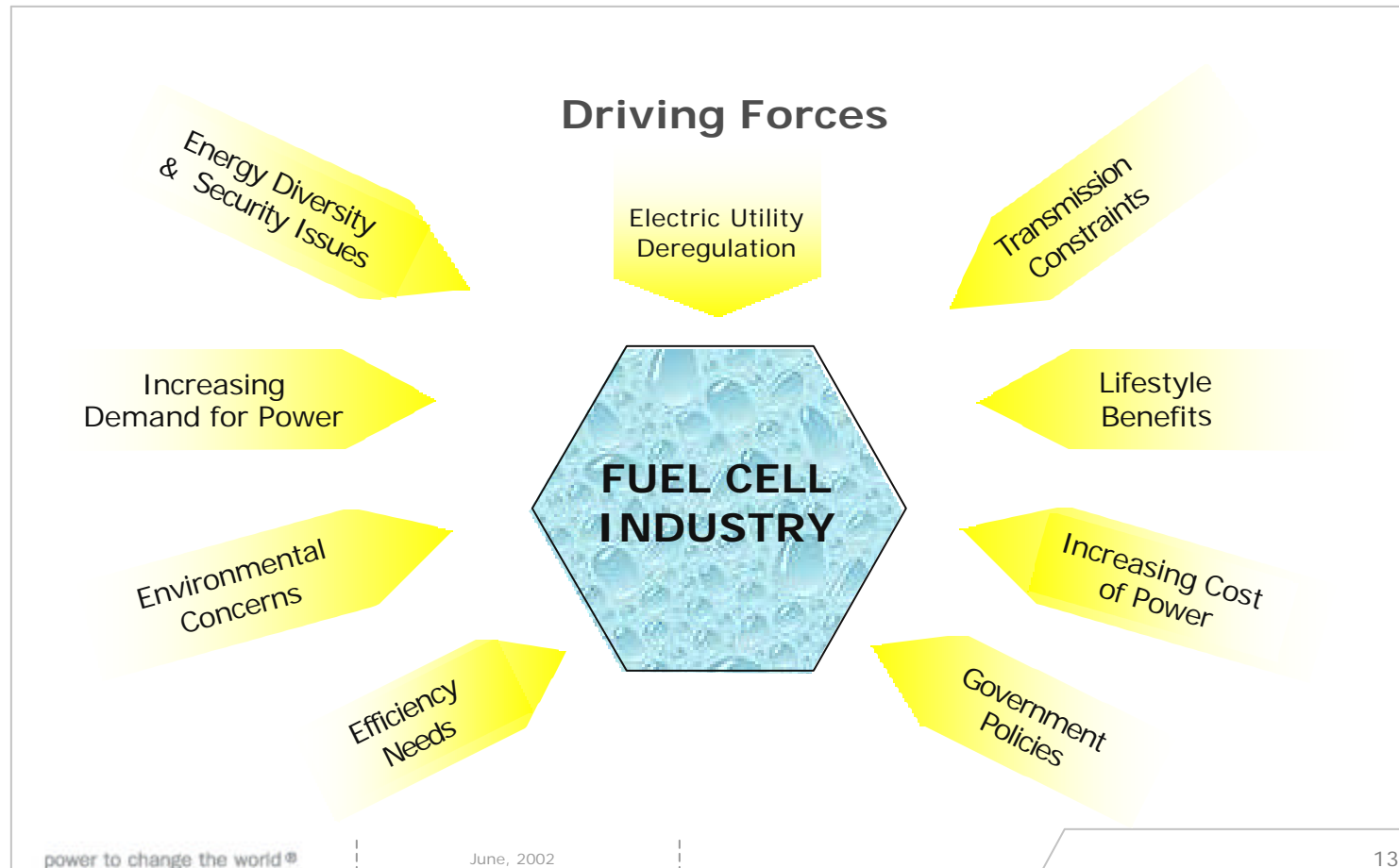
West Sacramento, California



Source: California Fuel Cell Partnership

The Time is Now for Fuel Cells

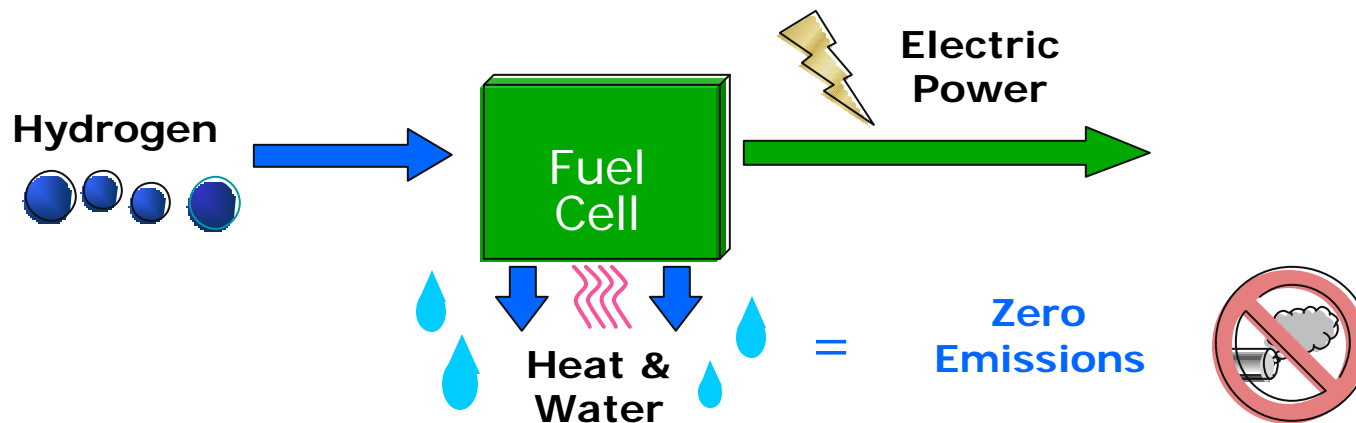
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Fuel Flexibility

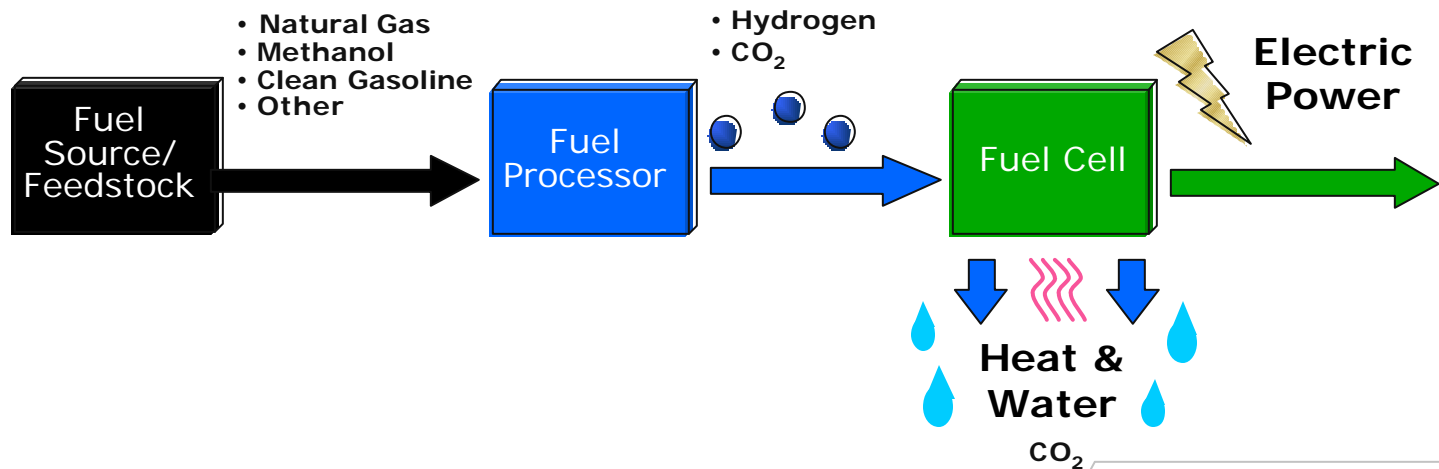
BALLARD®

- Ballard® fuel cells support a variety of fuels based on requirements.
- Continue to provide fuel cell solutions that meet our customers' needs.
- Ballard® fuel cells have operated on various fuels including hydrogen, methanol, natural gas, propane and butane.
 - Hydrogen as the fuel source achieves true "zero-emissions" quality



Fuel Flexibility

- Hydrogen can be extracted from hydrocarbon fuels
 - Based on advanced fuel processor technologies the emission of pollutants like NO_x , PM, CO is zero
 - The emission of CO_2 is significantly lower compared to combustion engines (proportional to the conversion efficiency)



What we need to do:

- Public Education
 - Hydrogen safety
 - Public awareness of fuel cell technology
 - Communicate environmental benefits
- Continuous improvement of reliability and durability
 - Public field trials
- Validate codes, safety and permitting/siting standards
- Continue involvement with California Fuel Cell Partnership
- Cost reduction
- Fuel infrastructure
 - Hydrogen production, distribution/infrastructure and storage must be developed



The Future

"...and what will men burn when there is no more coal? Water. Yes, my friends, I believe that one day water will be employed as a fuel, that hydrogen and oxygen that constitute it, used singly or together, will furnish an inexhaustible source of heat and light."

Jules Verne, *The Mysterious Island*, 1874

"...fuel cells will finally end the 100 Year reign of the internal combustion engine..."

Bill Ford, Chairman, Ford Motor Company (January, 2000)



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Thank You

**Please visit us at
www.ballard.com**